

**BRIAN E. McCANDLESS**

Institute of Energy Conversion  
University of Delaware  
Newark, DE 19716-3820  
Tel: (302) 831-6240  
Fax: (302) 831-6226  
E-mail: bem@udel.edu

**EDUCATION**

B.S., Astronomy, University of Maryland, College Park, 1980.

**EXPERIENCE**

9/80-Present            Institute of Energy Conversion, University of Delaware, Newark, DE  
Associate Scientist, 3/00-Present  
Research Associate III, 3/98-3/00  
Research Associate II, 3/85-3/98  
Research Associate I, 6/83-3/85  
Research Technician, 9/80-6/83

1976-80                University of Maryland Astronomy Program, College Park, MD  
Technician: Equivalent width analysis, 1978  
Technical Photographer, 1976-1980

**PROFESSIONAL EXPERIENCE**

Co-principal investigator on R&D contracts between the Institute of Energy Conversion and governmental, university and private institutions, including the National Renewable Energy Laboratory, (NREL), DARPA, the New Energy and Industrial Technology Development Organization (NEDO), BP Solar, SOHIO, ISET, University of Toledo, and Spire.

Contributing researcher on collaborative R&D with numerous groups worldwide.

Active participant in NREL National CdTe R&D Team since inception in 1996.

Presenter at numerous conferences worldwide.

Inventor and co-inventor on five US patents.

Author and co-author of over 80 papers.

Editor of special issue of Progress in Photovoltaics and co-editor of special issue of Thin Solid Films.

Co-author of a book chapter on CdTe thin film solar cells.

## **RELATED SKILLS**

Inorganic chemical synthesis and thin film deposition  
Spectroscopic analyses: AAS, EDS, XPS, UV-Vis, PL  
Diffraction analyses: XRD, GIXRD, Laue  
Microscopy: Optical, SEI, BSI, AFM, EFM  
Electronic analyses: JV, Hall Effect, Hot Probe, QE  
Metallurgy: cross-section preparation, etching, analysis  
Photolithography: positive and negative, developed monolithic tandem solar cell in 1985  
Glass and quartz shaping and fabrication: lenses, mirrors,  
Gas and chemical handling  
Machine shop: end mill, lathe, drill press  
Programming in Basic, Excel, Fortran, Igor, Origin  
Technical writing: proposals, reports, papers, safe operating procedures, monographs  
Technical reading proficiency in French and Russian

## **PRESENTATIONS**

"Chemical Vapor Deposition of Zn<sub>3</sub>P<sub>2</sub> Thin Films," Institute of Microelectronics, University of São Paulo, Brazil, (1982).

"The Effects of Air Heat Treatments on Completed CdS/CdTe Solar Cells," 6th European Photovoltaic Solar Energy Conference, (1985).

(Invited) "Astronomical Aspects of Megalithic Structures in Great Britain," to the Delaware Astronomical Society Annual Dinner - Lecture, Wilmington, Delaware (1985).

"Celtic History through Music," with Dr. Steven McLain, DuPont, to the Center for Lifelong Learning, University of Delaware, Wilcastle Center, Wilmington, Delaware, (1988).

"Optimization of CdTe/CdS Solar Cells for High Efficiency," 9th European Photovoltaic Solar Energy Conference, Freiburg, Germany, (1989).

"A Treatment to Allow Contacting CdTe with Different Conductors," 1st World Conference on Photovoltaic Energy Conversion, Waikoloa, Hawaii, (1994).

"Vapor Phase Treatment of CdTe/CdS Thin Films with CdCl<sub>2</sub>:O<sub>2</sub>," 25th IEEE PVSC, Crystal City, Virginia, May 1996.

"CdTeS Absorber Layers for Thin-Film CdTe/CdS Solar Cells," 26th IEEE PVSC, Anaheim, California, 1 Oct 1997.

“Characterizing Contacts to P-Type CdTe in CdS/CdTe Solar Cells,” 2nd World Conference on Photovoltaic Energy Conversion, Vienna, Austria, 8 July 1998.

Diffusion in CdS/CdTe Thin Film Couples”, 16th European Photovoltaic Solar Energy Conference, Glasgow, Scotland, 3 May 2000.

(Invited) “Thermochemical and Kinetic Aspects of Cadmium Telluride Solar Cell Processing,” Mat. Res. Soc. Spring Meeting, San Francisco, 17 April 2001.

“Role of Processing Chemistry and Stability on CdTe-based Solar Cell Performance,” NREL NCPV Solar Review, Denver, Colorado, 25 Mar 2002.

“Vapor Transport Deposition of Cadmium Telluride Films,” 29th IEEE PVSC, New Orleans, Louisiana, 22 May 1996.

“Cadmium Zinc Telluride Films for Wide Band Gap Solar Cells,” 29th IEEE PVSC, New Orleans, Louisiana, 22 May 1996.

“Correlation of Surface Phases with Electrical Behavior in Thin-Film CdTe Devices,” E-Mat. Res. Soc. Spring Meeting, Strasbourg, 19 Jun 2002

“Cadmium Zinc Telluride for Wide Band Gap Solar Cells,” High Performance PV Project Meeting, Denver, Colorado, 15 July 2002.

(Invited) “Thermochemical and Kinetic Aspects of Polycrystalline Thin-Film Solar Cell Processing” at Colorado School of Mines, Golden, Colorado, 28 Oct 2002.

“Cadmium Zinc Telluride for Wide Band Gap Solar Cells,” High Performance PV Project Meeting, Denver, Colorado, 20 Oct 2003.

“High Throughput Processing of Stable CdTe/CdS Solar Cells,” NREL Solar Review, Denver, Colorado, 26 Oct 2004.

(Invited) “Physical and Chemical Processes Controlling Composition and Band Gap in Polycrystalline II-VI Thin-Film Alloys,” 14<sup>th</sup> International Conference on Ternary and Multinary Compounds, Denver, Colorado, 27 Sept 2004.

(Invited) “Glancing Incidence X-ray Diffraction of Polycrystalline Thin Films,” Mat. Res. Soc. Spring Meeting, San Francisco, 28 Mar 2005.

“CdZnTe Solar Cells,” High Performance PV Project Meeting, Newark, Delaware 5 Oct 2005.

“Thin CdTe Solar Cells with High Throughput Processing,” NREL Solar Review, Denver, Colorado, 8 Nov 2005.

## **PATENTS**

U. S. Patent no. 4,709,466 dated 12/1/87  
"Process for Fabricating Thin Film Photovoltaic Solar Cells"  
Inventors: Brian E. McCandless and Robert W. Birkmire

U. S. Patent no. 4,909,863 dated 3/20/90  
"Process for Leveling Film Surfaces and Products Thereof"  
Inventors: Brian E. McCandless and Robert W. Birkmire

U. S. Patent no. 6,251,701 B1 dated 6/26/01  
"All-Vapor Processing of P-Type Tellurium-Containing II-VI Semiconductor and Ohmic Contacts Thereof"  
Inventor: Brian E. McCandless

U. S. Patent no. 6,537,845 dated 03/25/03  
"Chemical Surface Deposition of Ultra-Thin Semiconductors"  
Inventors: Brian E. McCandless and William N. Shafarman

U. S. Patent no. 6,676,994 dated 01/13/04  
"Method for Producing Thin Films"  
Inventors: Robert W. Birkmire, Erten Eser, Gregory M. Hanket, Brian E. McCandless

## **ACTIVITIES**

Editorial Board of Progress in Photovoltaics, Wiley, 2002-Present.

Team leader on National CdTe National R&D Team.

Member of Materials Research Society, Delaware Astronomical Society, American Association of Variable Star Observers, Cecil County Historical Society, Classic Yacht Restoration Guild, founder of An Ceilteach Muintir Ceol Cumann Folk Club and North American Lowland and Border Bagpipers Association.